Sampson H.C. 1922
(Tropus division Bf 22·3)

EMPIRE COTTON GROWING CORPORATION

THE EXISTING CONDITIONS OF COTTON CULTIVATION IN NYASALAND AND SUGGESTIONS FOR THEIR IMPROVEMENT

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LONDON
1922

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The Existing Conditions of Cotton Cultivation in Nyasaland and Suggestions for their Improvement

1. The conditions under which cotton can be grown in Nyasaland vary considerably in different parts of the country, and the area where it is grown at the present time is restricted to such parts as are either within easy reach of the railway or have access to river transport.

2. Physical Features of the Country.—Nyasaland is a long stretch of country running north and south. It is bounded on the east and west by high mountain ranges. In the centre, below the lake area, the Shire highlands are situated. Starting from the south, the lower reaches of the Shire Valley form the low country. The Shire River runs along the foot of the western slopes of the Shire highlands, and to the west of this there is a wide level plain or valley, which, as far as the Murchison Cataracts, forms the low country. This is comprised of the Port Herald, Chiromo, and Chikwawa districts. This area is only some 100 to 200 feet above sea-level. The Murchison Cataracts traverse about forty miles of the Shire River, and above these the level of the country is some 900 feet above sea-level. Following up the Shire River to the lake, the land gradually rises to approximately 1,500 feet at the lake shore. To the west it rises to the high country of the Neno and Ncheu districts, and to the east to the plateau which runs to the east of the Shire highlands, and which is comprised of practically the whole of the Zomba and Mlanje districts. This plateau is about 2,500 feet above sea-level. To the north, the country along the lake shores is the same level as the lake, namely, some 1,500 feet above sea-level.

3. Communications.—Practically all this country, as well as the valleys running down from the Shire highlands, is suited to the cultivation of cotton, but at present the area is very restricted on account of the high cost of transport to the railway. This railway hardly touches the cotton areas, except in the low country, which already has transport facilities by river. Port Herald is connected with the Zambesi River by the railway which runs due south to Chindio, and at the present time the opposite bank of the Zambesi River is being linked up with Beira by rail. After leaving Port Herald towards the north, the railway runs

through Chiromo, and almost immediately commences to climb the Shire highlands till finally it reaches Blantyre, which is at an elevation of some 4,000 feet. Thus all cotton, except that grown in the low country, has to be conveyed up-hill to the railway, and then run down to the Zambesi by rail. There is a proposal to connect the lake with the present railway. This will take off at a place called Luchenza, which is some 2,500 feet above sea-level, and it will run along the plateau to the east of the Shire highlands to Fort Johnston at the southern extremity of the lake. This will open up the lake area as well as the land on the level plateau to the east of the Shire highlands, but it will do little towards opening up the Shire Valley and the land to the west of this. One would have thought that the natural line for railway extension would have been up the Shire Valley starting from Chiromo, as this would have taken advantage of the gradual rise from some 200 to 1,500 feet between Chiromo and the lake shore, instead of taking off at a point high up on what may be called a mountain railway and running down to the lake. I presume, however, that this route has been examined, and, for reasons unknown to me, has been abandoned.

4. Climate.—Cotton can be grown almost anywhere in Nyasaland below a level of about 3,000 feet. There are sheltered valleys above this level where cotton can be grown, and there are exposed areas below this level where it is too cold for this crop, but as a general rule 2,700 to 3,000 feet may be taken as the maximum level, above which the cultivation of cotton is too risky to be profitable. The climatic conditions at these different levels vary very greatly. Everywhere, however, the cotton is sown during the warm weather which coincides with the rainy season, and ripens as the weather gets dryer and cooler.

5. Sowing Seasons.—At the higher elevations the sowing season is early—usually November to December—as the object here is to get the crop well on towards maturity before the weather turns really cold. As the elevation gets lower the sowing season is later, till at the extreme south in the Port Herald district the sowing season now adopted is as late as March. Here, however, another factor comes in in fixing the sowing season so late. Most of the fertile area consists of the alluvial lands in the region of the Shire River. This is always liable to flooding when the Zambesi is full, as this river banks up the waters of the Shire and causes it to overflow. Sowing is therefore delayed till the risk of this inundation is past.

6. There are other considerations which help to fix the sowing season in certain areas. In the Chikwawa area, for example, the best time for sowing has been found to be about the end of January. Earlier sown crops than this are very subject to bollworm attack,

which greatly lessens the yield as well as lowers the grade of the cotton. This is a matter for investigation by the entomological section of the Agricultural Department; for if it can be ascertained what are the wild plants which the bollworm breeds on, it may be possible to keep this in check. The late sowing season adopted here is not at all satisfactory from the point of view of crop production. It means that the cotton plant has to experience a long period of dry weather before ever the crop has developed its bolls, and this naturally lowers both the yield and the ginning percentage, besides checking the full development of the fibre. The low country cotton, taken as a whole, has not nearly such a good twist as that grown where the sowing season is earlier, and though it is finer and more silky, the ginning out-turn is very low. At Chiromo this season the best crop that I saw in that area only ginned at a little over 25 per cent., while in the Chikwawa tract the ginning out-turn is said to average about 27 to 28 per cent. These facts all point to the sowing season being too late. The weather conditions, apart from the drying out of the soil, appear to be suitable for the growth of cotton throughout the cold weather, and if a heavy rain occurs in July, the crop will make secondary growth which will often mature a crop producing more cotton than the season picking.

7. The very late season which has been adopted in the Port Herald area appears to be very risky. The crop is entirely dependent on the late rains, and if these fail, as they are apt to do, and as they have done this year, the crop turns out to be a complete failure.

8. With the early season adopted for sowing at high elevations the risk has to be taken of heavy rains damaging the young crop, and in some seasons the yield is very considerably reduced on this account. The safest area, therefore, appears to be that which is between the high and the low country—that is, at elevations between 1,000 and 2,000 feet—and it is likely that cotton cultivation will, if it is to extend, spread here rather than elsewhere so long as conditions are as they are at present. The main difficulty, however, in the way of this extension is (1) the distance from the railway, and (2) the presence of tsetse fly in parts. These areas consist of the upper Shire, west Shire, and south Nyasa, and will probably include the open plateau of the Zomba and Mlanje districts, as the climate here is less subject to extremes than would be the case if it were intersected with hills. The lake region will also have to be included when once this is connected up by rail communication with the Zambesi, but at the present time the heavy cost of transport from here makes the extension of cotton cultivation impossible.

9. Soils.—The soils where the land is level within the area

suitable for the growth of cotton are remarkably uniform in appearance. These, as a general rule, resemble in appearance the black cotton soils of India. They differ greatly therefrom, however, in texture since they usually contain a much larger proportion of sand, which makes them suitable for the cultivation of the hirsutum types of cotton. It is only where water collects—*i.e.*, in depressions in the lie of the country—that the soil resembles the black cotton soils of India in texture. Such soils are unsuited to the cultivation of American cotton. Aeration is lacking, and when there has been heavy rain or the land is inundated, the cotton crop is spoilt. The Ndinde Marsh in the Port Herald district is a good example of such a heavy type of soil, and though in a very favourable season it will produce an excellent crop of cotton, cultivation under such conditions is so risky that it cannot be recommended.

Wherever the country rises above the level of the plain, the soil changes from this dark loam to a red soil. Some of this is fit for cultivation, but much of it is shallow and would not stand continuous cropping. In the highlands the soil in the wider valleys is often a dark loam, but at the higher elevations most of the soils are red, and many of them are deep, appearing to merge into the rotten igneous rock below. In some places these red soils of the highlands are very rich, since they contain large quantities of organic matter.

10. Methods of Cotton Cultivation.—The existing methods of cotton cultivation, whether carried on by natives or Europeans, are very similar. Such differences as do occur are largely a question of degree in the care given to the crop as a whole. The European is, as a rule, more careful to sow in the proper season, and there is more method in his work. The lines where he sows his crop are properly laid out and straight, whereas the native will often sow his crop on heaps of soil rather than on straight ridges. The native has one advantage over the European planter in that he is not so restricted in the choice of the land which he wishes to cultivate, and will often abandon a clearing after the second year of cultivation to take up a fresh area. He also has the advantage of having at his disposal land which has formerly been under native crops, and which at some time in the past has been abandoned. Such land is often of excellent quality, and the native is saved the cost of clearing really heavy bush.

11. The first step taken to prepare land for cotton cultivation is to clear it of wild vegetation. All timber is cut at about 3 feet from the ground, and what will burn is disposed of by fire, the stumps of large and hard timber being left in the ground. Where the baobab tree is found this is left as it stands, it being too large

to fell and remove. After the burning, the land is hoed over with the native hoe. Sometimes the whole area is dug over, but in other cases it is only dug in parallel strips, some 4 feet apart. This dug strip forms the line on which the cotton crop is to be sown, and any loose soil is scraped on to this line to form the ridge. This work is usually finished before the rainy season commences, and the ridge is allowed to settle before the seed is sown. Where the sowing season is late, weeds have to be kept in check by hoeing, and where the whole area has not previously been hoed, the area between the rows is sometimes dug over to complete the cultivation of the land. The sowing is all done by hand labour, the seed being dibbled in with the aid of the hoe at intervals along the ridge. The spacing may be from 1 foot to 2½ feet, according to the nature of the soil and time of sowing. Where the sowing season is early and the soil is more open, the wider spacing is given, because here the plant grows much bigger. No care is usually taken to limit the quantity of seed sown, and very often quite a small handful of seed is sown in one place. When the plants are about 9 inches high, superfluous plants are thinned out, leaving two at each place. This thinning is done at the time of weeding. Subsequent weedings are done when considered necessary, but the number of such weedings is also governed by the availability of labour. At the final weeding the ridges are made up by scraping the soil from between the rows of plants on to the ridge. When the crop has been picked, the plants are either pulled out or are cut off below the surface with the hoe.

12. The cultivation for the following season may commence before the stalks of the previous crop have been removed from the ground, but whether this is the case or not makes little difference to the methods of cultivation adopted. The simplest form of preparing the land for the next year's crop is merely to make up the ridges of the previous year. Other more careful growers dig up between the rows of the previous crop, split the old ridge, and make a new one on the top of the newly dug strip. This is repeated year after year, till it is decided that the land no longer pays to cultivate with cotton, when it is abandoned and a fresh area cleared. I saw one field which had been cultivated continuously with cotton in this way for seventeen years, and still produced a fair crop.

13. The above are the methods of cultivation generally adopted, but there are growers in the country who do pay more attention to cultivation. In regions which are free from the tsetse fly, some growers own cattle, and usually employ these for ploughing—at any rate, a portion of their lands intended for cotton. There are growers also who are now introducing the use of bullock-power

implements for the intercultivation of their crops. Where the tsetse fly is present, however, no other implement than the ordinary native hoe is used.

14. *Cotton Growing under European Management.*—At the present time, it is estimated that about 80 per cent. of the total area under cotton is grown under European management, and hence this aspect of cotton production is now, and for some considerable time to come must be, of importance to Nyasaland. As far as I saw the country, there never has been any serious attempt at farming. I lay emphasis on the word farming, because there have been many serious attempts at cotton growing or tobacco growing. The planter who grows cotton grows practically nothing else. A few may grow both cotton and tobacco, and on sisal plantations cotton will often be grown between young sisal in order to assist in paying the cost of weeding. Where labour has to be imported from other parts of the country, sometimes a small area of grain crop is grown, but never enough to feed the labour throughout the year. No one has settled down to real farming and a proper rotation of crops, which is so essential to the proper growth of cotton.

One of the main difficulties in the way of real farming is the lack of markets for produce, and this is largely a question of the cost of transport, whether by road, rail, river, or sea. It is estimated that at the present time the transport alone from the railhead in the highlands to Europe is about a penny a pound. Of this amount about one-half represents the rail charges to Chindio. In addition to this there are packing charges to be taken into account, and as materials for this have also to be imported at these high rates, they come to no small amount. Tobacco, for example, costs about 2½d. a pound, inclusive of packing, etc., while cotton costs about 3½d. a pound, inclusive of ginning and baling, to get it to Europe. The crops most suitable as rotation crops for cotton are cereals and pulses, and it is impossible for them to stand these charges for export. At the same time, there is a certain limited demand within the country itself. Every farmer, for example, who uses "imported" labour, should produce sufficient grain and pulse to feed this labour. This is never done, however, and the purchase of such foodstuffs adds greatly to the cost of producing such crops as cotton. That the internal demand is not well supplied at the present is shown by the fact that export of grain is not allowed. This may, however, be purely a temporary measure on account of the failure this season of the crops in the low country. It is possible that if and when the transport charges are reduced, an outside demand can be found for such produce which will more than cover costs. This is all that is required, for

the revenue is expected from crops such as cotton, and if the rotation crops merely pay their way it would suffice. At the present time "Macheeri" (*Pennisetum typhoideum*) is being exported from Tanganyika Territory to India, while considerable quantities of pulses are imported into Nyasaland from neighbouring Portuguese territory, which might just as well be grown locally. Further, there is a large Indian population in Natal, and many of the pulses now grown by the natives in Nyasaland should find a ready sale there. Three of the main pulses grown in Nyasaland are commonly grown in Madras, whence the bulk of the Indians in Natal originally came.

15. It is possible also that other markets might be found for some of these crops. The "Mapeera" (*Sorghum vulgare*) of Nyasaland may be found to be as useful for the manufacture of malt as several of the Indian varieties have proved to be. Then, again, there is the possibility of utilizing these grains for feeding stock. Both bacon and ham can be cured quite well in the highlands, and a development of this branch of farming might utilize a large quantity of this produce.

16. *Crop Rotation.*—The cereal, then, is mainly required to pay for the cost of keeping the land under clean cultivation during the rainy season and to allow the land a rest from cotton. Such a change of crop is of the greatest importance. Cotton remains on the ground for some nine or ten months. By the time that it is removed the soil is quite dry, and efficient cultivation is impossible before the next cotton crop is sown. If a cereal is grown, this remains on the ground for some four to four and a half months of the rainy season, and by the time that it is removed there is sufficient moisture still in the ground to admit of thorough and deep cultivation. The land will then lie under a plough fallow for some seven to eight months till the next crop of cotton is sown, and this weathering of the soil will add greatly to its fertility, besides allowing for the much more even distribution of soil water during the following cotton season.

17. *Use of Cattle.*—Where cattle are available much more use should be made of them for cultivation. The present system of strip cultivation is bad, as it prevents the even distribution of water through the soil. This means that after heavy rain the cultivated strips are often waterlogged, and this has probably been one of the reasons why the cotton is always sown on ridges. If the land is ploughed the whole area receives proper cultivation, and this tends to an even distribution of water in the soil in the following rainy season. Not nearly enough use is made of the available draught cattle in the country for cultivation. In the first place, they are seldom treated as draught animals. Usually they are turned loose in the kraal for the night. The kraal is seldom cleaned, and often the animals have

to stand knee-deep in filth and can get no rest. The animals are never fed. All that they get is what they can pick up when they are sent out for grazing at times when they are not at work. Sometimes, where there is a ginning factory attached to the estate, they get a certain amount of cotton-seed from the waste heap where the seed from the gins is thrown. The animals are never washed or groomed, though, since the recent advent of East Coast fever, they are now regularly and compulsorily dipped. Thus the animals have no stamina; they are never properly broken in to work, nor are they used to being handled. When working they are never driven, but are invariably led, and consequently they only move at about half the pace they would do if they were driven. The idea of working them as a single pair unit rather than in a team of several pairs does not seem to have occurred to the growers here. This would certainly be the right method of working them for either preliminary or after-cultivation.

18. Instead of the heavy two- and three-furrowed ploughs now imported for use, much more rapid and nearly as effective work could be done with a plough of the type of the "Monsoon" plough, made by Messrs. Ransome, Sims and Jeffries, or the "Vitis" plough, made by Messrs. J. and F. Howard, if cultivation could be done while there is still moisture left in the ground. This would be the case if ploughing were done after the harvest of a cereal crop at the close of the rainy season. One of the great advantages of these small ploughs is that the driver is right behind his animals and not several feet away from them, as he is when a plough having stilts is used. This is an important point, as cattle have constantly to be urged along.

19. *Sowing.*—The present method of dibbling in the seed is open to the following objections: (1) The land has to be laid out into ridges and furrows so as to form a guide for the labourers where they are to sow; (2) it is very difficult to regulate the distance between mounds, the depth at which the seed is sown, and the quantity of seed sown on a mound. When the seed comes up there may be twenty to thirty plants at one place. These have all to struggle for existence till thinning can be done, and, since weeding has to be done before thinning, this means that the plants are often drawn up and weak when they are thinned out, while the root system of the remaining plants is apt to be disturbed during the process of thinning; (3) where sowing is done by dibbling, one can often pick out the work of bad sowers after the crop has come up. This means blanks that have to be filled up, and these being sown after the right season never do as well as the main crop. Further, this means that the crop does not mature its cotton all at the same time, and this assists in keeping the bollworm alive. The "task" system,

which is generally adopted in Nyasaland, accentuates this last objection. All workmen are given the same amount of work to do in the day. Thus a rapid workman may scamp his work in order to get finished quickly, while a poor workman has to hurry in order to get his task finished within the day. Some improvement in the sowing could be effected by dressing the seed beforehand so as to separate the grains one from another. In India this is always done. The seed is placed in a heap and a watery mixture of cow dung is poured over it. The seed is then rubbed by hand so that each grain has a thin coating of cow dung, which, when dried in the sun, makes the short fuzz adhere to the seed and each grain is separate. This makes it much easier to handle the seed and to regulate the quantity sown. Where cow dung is not available a thin starch gruel made by boiling mealie meal could be used instead.

It would be very much better, where it is possible, to sow the seed with a drill so that the young plants would come up all along the line of the drill. Then each seedling would have an independent chance of developing, and thinning could be done much more easily, leaving only the best plants, and this without disturbing their root system. In Southern India such sowing would be done by dropping the seed in the open furrow of the ordinary wooden plough and covering it by a second plough furrow run parallel to the first and close to it. In some parts of India a bamboo tube is attached behind the plough with a cup at the upper end. The ploughman besides guiding the plough feeds the seed into this cup, whence it runs down into the plough furrow. The ordinary Indian bamboo seed-drill is a modification of this to sow two more furrows at a time. It is very efficient, besides costing very little and having a very light draught.

20. *Ridging.*—All cotton in Nyasaland is grown on ridges. This, to my mind, is a very doubtful practice. Rain-fed cotton in India is always grown on the flat, whether indigenous or hirsutum varieties of cotton are grown. Ridging is only seen where irrigation is resorted to, and not always then. It is true that germinating cotton is very liable to be killed out if heavy rain occurs immediately after sowing, but I consider that the advantages of flat cultivation are so great that it is preferable to take the risk of having to re-sow. With flat cultivation hoeing and weeding can be done much more expeditiously, whether bullock power or hand implements are used, and weeding can be done right up to the young plants. The cost of flat cultivation also is much less. It is much more easy to conserve moisture in the soil with flat cultivation, because not nearly such a large surface is exposed to the sun's rays or to the action of the wind. The roots of the plants also can spread equally in all

directions, while in ridge cultivation these are largely confined to the ridge. In Nyasaland the rains cease about the end of March. The cotton plants will then be from two to four months old, according to the part of the country where the crop is grown. Picking will not commence till the crop is from five to five and a half months old. The crop has, therefore, to endure a long period of dry weather just at the time that it requires all the moisture that it can get, not only for swelling the early formed bolls, but for setting the later formed bolls. Most growers at this time give the plants a final earthing up, and often these ridges are more than 18 inches in height after this operation is completed. The soil is scraped up from between the rows on to the ridge, leaving a hard clean-cut surface between the ridges which causes the soil to lose moisture very quickly. Naturally the crop becomes unhealthy, and I am of opinion that the disease of bollrot is accentuated by the starvation of the plant due to the rapid drying out of the soil.

21. *After-Cultivation.*—With the exception of one or two growers, who have commenced to use bullocks for inter-cultivation, this work is done entirely with the native hoe. Even with the cheap and abundant labour which is available this is both slow and expensive, and the work cannot always be done at the right time. After-cultivation should commence as soon as possible after the seed has germinated, the object being to destroy weed seedlings before they have a chance of becoming established. In the tropics this is of the utmost importance, since weeds grow at such a rapid rate that there is the danger of the crop being suppressed. Such rapid work is impossible where dependence has to be placed on the hand hoe alone. Even in the few cases where bullock hoes are used these cannot do the work either efficiently or expeditiously. The system of growing the crop on ridges makes it impossible to work these hoes close up to the young cotton plants, and the hoes in use are of the pattern of those used in Europe or America, which means that the workman is so far away from his animals that these have to be led by an additional hand. The bullocks under these conditions move very slowly, and much time is wasted turning at the end of the furrow. The Indian blade bullock hoes are much better suited to the needs of this country. They are light and can be lifted over stumps, and further they can be adapted so that, in places were cattle cannot be kept, they can be drawn by hand. Samples of such hoes were made at Zomba for the Agricultural Department.

22. The final hoeing should be done as soon as possible after the rains have ceased, and the object of this should be to form a soil mulch and thus check the loss of soil moisture. Moisture in the soil is wanted more at this time when the bolls are swelling than

at any other. It is not only wanted by the plant, but it helps the soil to retain the heat absorbed during the day.

23. *Manuring.*—The practice of manuring cotton is unknown in Nyasaland, and it is doubtful if this would prove any advantage if the manure were to be applied directly to the cotton crop. If, as I have suggested, a cereal or a pulse could be grown as a rotation crop, this could be manured with advantage and the cotton would benefit by the manurial residue left in the soil. Direct manuring of the cotton crop would tend to keep the roots of the plant near the surface, and it would then be unable to stand the dry weather when the bolls were swelling. Where cattle are kept no attempt is ever made to use the manure, partly because this contains so many weed seeds and partly because of the difficulty of getting it on to the land. These difficulties could be largely got over by firstly feeding the cattle instead of turning them out to graze, and secondly by the introduction of a bullock cart for a single pair of cattle in place of the cumbrous South African ox wagon now in general use. On estates where ginning is done the only use which is made of cotton-seed is to use this as fuel for the engines, except for the small quantity which the cattle are allowed to pick up. This, if crushed, should prove a very valuable manure for the cereal crop. Tobacco growers are beginning to use this as a manure for tobacco, but there is no reason why the cotton grower should not utilize this himself, as it is very necessary that he should do what he can to maintain the fertility of his land.

24. Picking and Grading.—The usual practice has been to allow the bulk of the cotton to burst fully before commencing to pick. Many growers were under the impression that until the cotton was practically falling out of the open boll the fibre was immature, and burst cotton would often be left in the field for a month or six weeks without any attempt being made to pick it. It has also been the practice not to start picking till the sun was well up and the moisture from the night dews had gone off the plants. The result of this is that the cotton, as picked, must contain a quantity of leaf, as it is almost impossible to pick the cotton without breaking off the dead bracts which surround the boll, and which become very brittle as they dry in the sun.

25. Some growers do the grading in the field, each labourer being made to pick the clean and undamaged cotton into one receptacle and the stained cotton into another. In other cases the labourers pick all the cotton that there is, and this is graded afterwards, often by a separate set of workers (usually children). The labourers, when they pick, pull out the cotton from the bolls and leave the shells on the plants. In India the best picking is probably that of the "Tinnevelly" area, and this cotton has always been noted for

its freedom from leaf. Here the pickers pick the whole boll by the stalk with one hand and with the other remove the cotton. The shell is then dropped to the ground. The empty shells on the plant are objectionable, since the bracts on these are easily broken off and stick to the cotton, which opens subsequently.

26. Usually the cotton is graded carefully. That is to say, all stain and leaf, etc., is picked out, the resultant clean cotton being called "Grade I." "Grade II." consists of the better quality of the stained cotton and cotton attacked by bollworm, and often all the later pickings are added to this. "Grade III." consists mainly of immature cotton. Much of this immaturity is due to disease, and most of it is badly stained; some, however, is due to the forced early maturity of the boll from bollworm attack. If the attack has been only in one lock, the rest of the cotton, though immature, may be quite white.

27. With this system of grading it can be readily understood that one person's "Grade I." may be very different to another's. A crop where there has been very heavy bollworm attack, or where bollrot stain has been very prevalent, will give a much weaker "Grade I." than a healthy crop; and a crop which has been sown late will always give a poorer staple than one which has been sown at the right time.

28. Whether grading should be done in the field or not is largely a question of what labour is available. If this is plentiful there is no objection to it—in fact, it is probably preferable. But labour is usually scarce at this season, since the natives have all harvested their own crops and have no need to go out to work, and, if this is the case, there is no doubt that grading afterwards is preferable. Cotton, if left in the field after it has burst, gets very dirty. Bush fires are common and the smuts from these settle on the cotton and spoil its colour. Whirlwinds, which are of frequent occurrence, blow up broken leaf, which adheres to the cotton. It may also be badly soiled by an occasional shower of rain. Moreover, the open bolls are usually full of stainers, which do not improve the colour of the cotton. The cotton also loses its brilliancy and looks dull. Further, the constant bleaching each night from the heavy dews will probably weaken the fibre. The first consideration, therefore, is to get the cotton picked as soon as possible after it has burst, if necessary leaving the grading to be done afterwards.

29. Where grading is done afterwards this is either done on mats on the ground or else on raised platforms made of the stalks of elephant grass; very few growers do their grading in the shade, and as the sun's glare on the white cotton is very great, it is likely that the work would be done better and more expeditiously if it were done in the shade. It must be almost impossible to distin-

guish slight stain in the glare of the sun. A dry sand floor would be a great improvement on the mats, for if the cotton blows about it does not matter since the sand will not soil it nor will it cling to it.

30. In some cases the growers try to get rid of stain by spreading the cotton out on raised platforms, and leave it thus for several days and nights, turning it each morning. The surface of the cotton gets wet with the night dews, and when subsequently exposed to the sun the stain bleaches out. Since all stained cotton is weak in staple, much of it being so weak that it is of little use in spinning, this practice is one which should be discouraged, as it only gives the cotton the appearance of being better than it really is, and this will not improve the name of Nyasaland cotton.

31. The present system of grading is all that the grower can do by himself. It has already been pointed out how one grower's "Grade I." may differ from another's, but as long as these are all put on to the market as "Grade I." under each grower's own mark, there is no chance of his getting the full market value, unless he is working on a very big scale and his mark is recognized on that market. There is little doubt, however, that if definite standards were instituted an expert grader could classify all these different lots of so-called "Grade I." and put them in their relative places. This would mean that all growers would have to accept this grading, and that the expert appointed would, if not actually a Government official, have to be under authority of the Government.

32. If this is accepted, the next question to decide is when this grading should be done. I would strongly advocate that it should be done at the ginning factories before the cotton is ginned, and for the following reasons: It is much easier to get a representative sample from unginned than from ginned cotton. It is possible to gauge what amount of preliminary sorting has been necessary. If much has had to be done, the locks of cotton will be broken much more than in the case of a well-grown crop. Weakness of staple, therefore, will at once be suspected. Twist, length, and evenness, can much more easily be recognized in unginned cotton.

33. I realize the difficulties of this proposal. In the first place, it is very difficult to get an expert who has had experience of grading unginned or even unpressed cotton. It would also mean that this officer would have to spend the whole time during the ginning season travelling from one gin to another. All gins would have to be registered, and probably the machines themselves would have to be inspected, since much damage is often done to cotton by bad ginning.

34. The advantages to the cotton growers would, I imagine, be great. These standards of Nyasaland cotton would be known on

the European markets. The consumers would know what they were buying and could, therefore, offer the full market value. They cannot do this now as they are not certain of what they will get, and the cotton may prove unsuitable for the purpose for which it is intended. There would be forward quotations for this cotton on the English market which, I presume, could be utilized by the banks for financing the crop. At present the banks are unable to assist as they do not know what will be the value of the cotton by the time it is sold in Liverpool or Manchester. This steadying of the market would also be of great use in assisting the sales at the Government cotton markets where native-grown cotton is sold. This year there was practically no competition to buy since no one knew which way the market was going to go.

35. Transport, Ginning, and Baling.—Internal transport and rail and shipping freights form the limiting factors in the cultivation of cotton in Nyasaland. Large areas of country are quite suited to the cultivation of cotton, but they are out of the question till better means of communication are afforded. The main roads of the Protectorate are, on the whole, good, but more are required, and some of those which do exist require to be better graded. The less important roads are frequently bad. Bridges are too weak to carry a load, and in many cases these have to be frequently cleared of high grass since the traffic is nowhere heavy enough at present to keep it down. The chief means of transport is at present carriers, and the cost of this may be reckoned at from ¼d. to ½d. a pound for a load of 60 pounds per 100 miles, or about half these rates if a return load is available. Ox-wagon transport was feasible till quite recently in districts which are free from tsetse fly, but on account of outbreaks of East Coast fever this had, for the time being, been stopped. A more recent form of transport is the motor-car, trailer, or lorry, but on account of the heavy cost of petrol, oil, and tyres, this works out at about twice the rate of carriers: £12 a ton is the charge from Fort Johnston to Limbe, a distance of a little over 100 miles. Recently some growers have been using hand carts pulled by human labour. These seem likely to be useful, but better grading of the roads is necessary if their use is to become general. It is certainly much more efficient than the head load, and not nearly such a strain on the labour employed. Railway rates from Limbe to Chindio on the Zambesi are ½d. a pound. In addition to this there is the river steamer freight from Chindio to Chinde, the sea freight from Chinde to Beira, and the ocean freight from Beira to the European markets. The pre-war freight from Limbe to England is stated to have been about £4. 14s. a ton, which is less than the present rail charges on the Nyasaland railways alone. Things may improve when there is through rail com-

munication between the Lake and Beira, but this is looking a long way ahead.

36. Since road transport charges are so high, it is necessary that the grower should gin his cotton as near as he can to where it is grown. The tendency, therefore, is for the multiplication of small ginning factories rather than the erection of the large factory, which in more developed countries would be the most efficient as well as the most economical practice. The large factory requires little more supervision, it will have better repair shops, and will carry a larger stock of spares. These are all considerations which help to keep up the cost of ginning in Nyasaland, for though the wages paid to the worker in the ginning factory are probably the lowest in the world, the overhead charges are probably higher than anywhere else.

37. *Gins.*—The type of gin most commonly used is the single-roller gin. In a few places the saw gin is used, and several growers who are at a distance from a ginning factory own small hand-worked saw gins. I do not see that there is any advantage in the single-roller gin over the double-roller gin as far as the ginned cotton is concerned. It takes up twice the space that the latter does for the amount of cotton ginned, and requires twice the length of main shafting to work the gins. The seed all falls on to the operating levers, and is scattered all over the floor of the factory. This is most objectionable, since there is always the danger of the seed being mixed with the ginned cotton. In the double-roller gin with the overhead gearing there is no trouble of this sort, since the seed all falls through into a seed chamber built under the ginning room, and there is no possibility of it being mixed with the ginned cotton. No one in the country appears to have ever seen an up-to-date ginning factory, and all the factories that I saw were badly arranged. Many of the modern factories in India, which are fitted with double-roller gins, are very well arranged, and it might be well worth while getting plans of these.

38. *Presses.*—There are several large presses in the country—in fact, many more than the present condition of the cotton industry warrants. A couple of presses could more than cope with the whole cotton crop of the Protectorate if they were suitably situated. In addition to these large presses there are large numbers of small baling presses, which put up the cotton into half-pressed bales of about 100 to 120 pounds. These are essential as they make a convenient load for two carriers, and it is thus taken into the larger presses, where it is put up into the 400-pound bale for export. The bales when ready for export are very much larger than the Indian 500-pound bale. I was told, however, that the pressure was according to the instructions of the cotton trade. The number of bands on the bale are too few, and the bales spring up appreciably when

taken out of the press. This must, I presume, add considerably to the freight since they cannot be packed so closely as the well bound and pressed Indian bale. These are questions on which I have not had any experience, however, but anything which can cheapen the freight to England will materially assist the industry at the present stage.

39. It is worth considering whether the Empire Cotton Growing Corporation could see its way to subsidizing all gins and presses which work at a reduced rate. The present charge for ginning and baling is £11 a ton. This was the price charged by the B.C.G.A. factory at Port Herald. Some of the up-country factories, where there was no competition, charged higher rates than these. I imagine that this high rate is charged because the factory has to carry the overhead charges of a European engineer as well as interest on the capital cost of plant; and until the quantity of cotton brought for pressing and baling greatly increases, the charge must be high if the factory is to pay its way. This rate works out at over a penny a pound for all cotton ginned and baled, and at the present state of the industry it is difficult to see how it can afford to pay these charges.

40. Insect Pests and Fungus Diseases.—There are three species of bollworm which have been identified—viz., *Diparopsis castanea* (the red bollworm), *Earias insulana* (the Egyptian bollworm), and *Chloridea obsoleta* (the American bollworm).

Of these, the red bollworm is undoubtedly the worst, though the Egyptian bollworm is frequently met with in the low country. The life history of the red bollworm has been worked out, both by Ballard and Mason, but apparently only in the upland neighbourhood of Zomba. Ballard reports that the life history takes the following periods: one month to pupation, followed by a 25- to 30-day pupation period. Mason reports variations from this as follows:—Egg stage, 2 to 5 days. Larval stage, 22 to 38 days. Pupa stage, 13 to 49 days.

The eggs are laid either on the stem, leaf-stalk, or stalk of the bolling branch. The larva may feed on the leaf at the start, but finds its way to a flower-bud, flower, or young boll, and having eaten out the contents of this, will then proceed up the bolling branch, attacking each boll in turn till it is full grown. When full grown it crawls down the stem to the ground, where it pupates within an earth cell, which it makes under the surface of the ground. That this bollworm has other host plants besides cotton is very evident, since crops on new clearings which are several miles from any other cotton may be very badly attacked. I was informed that Mason had discovered several other plants on which this pest feeds, but no written record appears to have been kept of this. It is

probable that in the tropical conditions of the low country the life cycle of this pest may be considerably shortened.

41. No method of dealing with this pest, other than those recommended by the Agricultural Department, can be suggested. These are (1) to hand-pick and destroy the caterpillars when they first make their appearance, and thus reduce the pest during the first generation before they have time to multiply; and (2) the enforcement of the ordinance requiring the pulling up and burning of the old stalks by a given date after the picking is completed. The other species of bollworm are of minor importance compared with the red bollworm, and remedial measures are the same.

42. Both aphis and leaf hoppers sometimes do considerable damage, and several large patches were seen in different parts of the country where aphis attack had resulted in the plants bearing no crop at all. Mason's recommendation of spraying with tobacco water for the aphis when the attack is first observed may destroy this in the initial stages and prevent it from spreading. Leaf hoppers may also do considerable damage by sucking the juices from the underside of the leaf and causing it to curl up. This is especially noticeable on plants which have the smooth leaf and stem. This, I have observed in India, is one of those insects which are farmed by ants, and probably they object to the hairy stem and leaf when smooth-leaved plants are at hand. In any case, the presence of this pest as well as the aphis can usually be told by the activity of the ants in the field. Many growers seemed to be under the impression that these ants are feeding on and destroying these pests. This is far from the case, as they are really nursing them and carrying them from one plant to another, where fresh food is to be found.

43. The red and dusky cotton stainers are both very prevalent, though the latter seems to be confined more to the low country. Except when crushed, they do not appear to do any appreciable direct damage to the crop. Most of the stain, which in the past has been attributed to these pests, is due to a fungus, or possibly to a bacterial disease. That this is so is proved by the fact that the cotton is already stained before ever the boll opens. It has been suggested in the West Indies that the stainer, in sucking the juices from the plant, pierces the outside of the green boll and inoculates with the disease the immature cotton within. Certainly something does appear to pierce the green boll, as on the inside of the fruit wall there are gall-like swellings, which look as if the fruit had tried to heal the damage. Such gall-like swellings in India may be caused by the pink bollworm, since in otherwise healthy bolls the newly hatched larva of this pest can frequently be located lying immediately under the swelling. Thus it may possibly be that the

same is the case here, but that the larva is killed when, instead of reaching healthy immature fibre in the boll, it comes across the rotten mass of diseased wet fibre. On the other hand, these galls may be caused by sucking insects piercing and irritating the boll.

44. The red spider also seems to cause appreciable damage. Where this is present the upper surface of the leaf assumes a copper-coloured appearance and becomes very unhealthy. This, again, is a pest which appears to spread from a centre, and if noticed before it has spread to any extent can be checked by pulling out the infected plants and burning them.

45. Other pests recorded by Mason besides leaf caterpillars are a stem weevil and a leaf-eating flea beetle. I only saw these in one locality.

46. The most serious pest which attacks cotton in Nyasaland is the fungus or bacterium already mentioned which causes "bollrot." This disease appears to be much worse in some years than in others, and, even in a good season, all late-sown crops, as well as the late pickings of the season crop, where the crop has been sown in proper season, are attacked. The disease is evidenced by the presence of bolls which do not fully open, and when the cotton is picked the lower half of the lock remains in the boll. The cotton may be stained only round the seed, which shows up in the seed cotton surrounded by a halo of yellow-stained fibre. Where the attack is severe the whole of the lint is stained yellow, and in this case it is immature and very weak. Even where the fibre is only stained just around the seed the fibre is not fully developed, and has not its full strength. Where the attack is in evidence it is hardly possible to find a sound green boll among the late maturing crop. It is also remarkable how it seems to be more prevalent in some seasons than in others. Thus, last year only about ten to twelve tons of seed cotton were brought in by native growers to the cotton market at Balakas (Ncheu district), and European planters also had a complete failure of crop. This season the crops here are remarkably good, and though the area sown, as reported by the district authorities, was the same as last season for native cultivation, the amount of seed cotton brought in to the market this year was about seventy tons, of which all but about ten tons were of the first grade and of excellent quality. The same applies to the Europeans' crops of the neighbourhood. The disease appears to kill the seed, and when this is opened the endosperm is quite dry and powdery. The disease may appear as if it had been caused by the puncture of an insect, as it sometimes seems to arise against the outer wall of the fruit carpel. At other times, however, it seems to start in the septa separating the carpels, and again at other times the central core of

the fruit appears to be first attacked. In this last case the disease is often confined to the lower point of the locks.

47. It seems probable that the disease is accentuated by unfavourable conditions of growth. It may be that the sudden approach of cold weather, which often sets in as the crop is ripening, may increase the virulence of the disease, or it may be that the sudden cessation of the rains and the consequent rapid drying out of the soil may cause unhealthy conditions of growth. As already mentioned, one of the main defects in the present system of cultivation is that the final soil mulch is deliberately destroyed at the time of the last earthing up. This not only makes the soil conditions too dry for the cotton plant, but this rapid evaporation makes the soil very much colder than it would otherwise be. Not only does the evaporation cause this, but the soil being dry cannot retain the heat which it accumulates during the bright sunshine of the day.

48. Another disease which does a fair amount of damage is one which follows the attack of the bollworm, and this is caused by the fungus *Aspergillus niger*—the common black mould. This gains entrance through the hole made in the boll by the bollworm and feeds on the fibre within the green boll, and the whole surface of the lock is quite black with the spores of this fungus, while at the same time the fibre is much weakened. This, if present in any quantity, can completely spoil the sample of cotton, giving it a dull grey colour.

49. Cotton Growing by Natives.—Although much progress has been made in the introduction of cotton as a native crop, it is as yet by no means established, and the native very easily gets disheartened. At best he is a poor cultivator, and has no further ambition than to grow only as much as will fulfil his actual requirements. He is an excellent judge of land, and he knows the seasons when his own crops should be sown, but he has seldom got further than hoeing the ground into heaps for drainage and sowing his seed on the top of the heap. In all the low country the native cultivation hugs the banks of the rivers and streams, on which the people are dependent for their water supply. No implement other than the hoe is known or used, and the crops are usually very foul with weeds. Cotton when grown is often put in as an after-thought. This is especially the case in the low country, where it is frequently seen as a second crop following the grain crop on the same land. There is considerable difference also between the different races of people. As already mentioned, the low-country native will seldom cultivate away from the river banks. The Yaos, who live between Zomba and the Lake, do not take kindly to agriculture, and are quite content to grow only their own requirements in the way of grain pulses and vegetables. The Angoni, where they come down

to the lower elevations, are very much more industrious, and it is here that native cultivation of cotton has made most headway—*i.e.* in the Ncheu district. At higher elevations beyond the tsetse-fly belt they are a pastoral people. Some of the Lake people seem to be better cultivators, but at present they are too far from communications to warrant their taking to cotton cultivation. It is very seldom that the native has any ambition to improve his position by agriculture, and he still remains quite content with his village life. It was always a wonder to me why the native, having no ambition, ever left his village to come and work. As field-workers none of the natives of Nyasaland are to be compared with the Anguru from Portuguese East Africa.

50. Whether the European is to continue growing cotton indefinitely is very doubtful. As far as I can see he is bound to give place to the native sooner or later, since the parts of the country where cotton is likely to thrive best are the less temperate regions of the Protectorate, where it is doubtful if the European can make a permanent home. At the present time, however, there are many Europeans attempting to settle here, and they are very necessary if the crop is to be established. He has the energy, the will, and the mental capacity to make the crop a success, and further he works on a big enough scale to assist materially in the work of establishing a definite strain of cotton. Ultimately it is probable that the European will do the handling and export of the crop and the native will do the growing.

51. There is no doubt that at the present time the cultivation of cotton by the native has received a serious set-back. He cannot understand why it is that he only gets the same price for his cotton now as he got before the war, whereas he has to pay from three to four times the price for cotton cloth. Cloth is about the only article for which he requires money, and this means that the price he is now getting has only about a quarter the purchasing value it had before the war. Naturally he is discouraged, and the incentive for growing cotton has to a great extent gone. Further than this, he is not now buying cotton clothes nearly so freely as formerly. His civilization is of such a recent date that it takes little to make him lapse again to the clothing to which he was formerly accustomed, and one sees a large proportion of natives now dressed in skins, bark cloth, or old gunny-bags rather than pay the price for cotton cloth.

52. The Present Type of Cotton Grown.—According to the official figures, some 80 per cent. of the total crop is grown under plantation conditions—that is to say, only some 20 per cent. of the crop is grown by the native. Government have in the past done all that they could to encourage the cultivation of this crop by the

native. In fact, they have paid so much attention to this aspect of cotton cultivation that they have rather neglected the European planter, and have not made use of his services in the important matter of seed supply for the country. Whereas Government have always supplied seed free of charge to the native grower, they have never done this for the planter. Only very rarely has seed of the strains raised on the agricultural stations been made available to the planter, and that for purchase only. There is no doubt that the policy of fostering the native industry is right, but when it is a question of maintaining an adequate supply of seed of a particular strain some more certain and reliable agency, if available, should certainly be made use of.

53. The result of this past policy has been that the planter has had to make his own arrangements for his seed supply, and his crop is now frequently a hopeless mixture of the several varieties of upland cotton which have from time to time been imported into the country. Many of the larger growers have paid a good deal of attention to the selection of seed for sowing, but this has been done on the system of selecting the best developed plants, and the result of this has been that, more often than not, natural crosses have been selected for seed, since these always show up well in growth owing to the increased vigour from the new blood introduced. Then, again, many planters will buy their seed from others who in the previous year have sold their cotton for a good price or from those who have in the previous season had a good yield. This is often done regardless of the elevation at which the seed crop was grown. Others, again, will merely use the seed of their No. 1 grade cotton which they get back from the ginning factory.

54. There are places where cotton has been grown continuously from the same seed year after year for several years, and this has considerably altered the type of the plant by the process of natural selection. Thus, in the low country as well as in the middle country the plant is much more hirsute than it is in the high country, since the rough or hairy plant is able to stand the hot climate better than the smooth-leaved plant, and therefore this type of plant now predominates.

The plant, again, which is grown at Magomero (Major A. L. Bruce's estates) is also more or less of a type of its own, and can generally be recognized.

The strain No. 57 which was produced at the Government experimental station is also a more or less distinct type, though there is no doubt that it has deteriorated either by crossing or by the seed having become mixed.

55. Though there are these more or less typical strains of cotton, the type is only a matter of the habit of the plant and the effect of

the climate. There is no uniformity in the staple of any cotton seed grown in the Protectorate. The length of staple varies from three-fourths of an inch up to nearly an inch and a half. In some plants the staple is fine and silky, while in others it is coarse and harsh. In some the natural twist in the fibre is well developed, while in others there is practically no adhesion when the seed cotton is pulled apart. There is a variation in the ginning out-turn, which may amount to as much as 10 per cent. between plants grown in the same crop. There is also great variation in the weight of the seed.

56. An examination of the seed cotton in the field showed, however, that there was plenty of good cotton still in the country if only it could be separated from the bad and the indifferent; and the necessity for making fresh selections was clear, so that fresh strains could be produced from the acclimatized crop. These were made at places representative of the different elevation zones. Those in the low country were made at the British Central African estates near Chikwawa (other selections were also made at the Government Farm near Port Herald, but these had to be made when the crop was still in flower, and later on the cotton suffered so badly from bollrot that no sound cotton was picked). Those in the middle elevation were made at Mlosi, which is between Zomba and Liwonde, at Mpali between Liwonde and Fort Johnston, and at Liwawasi, near Balakas, in the Ncheu district. Those at the higher elevation were made at the Government Farm at Namiwawa, near Zomba. These last were made by the officer in charge of the station before my arrival as the crop was over, except for the late pickings, by the time I arrived there. I was, however, able to examine the plants in the field and to make a selection from those that he had marked and harvested separately. In all places selection was first made for the type of plant required—*i.e.*, its shape and the hairiness of the leaf. Care was taken to reject all plants which by their excessive vigour indicated that probably they were the first generation of the results of natural crossing. A rough examination was, where possible, made in the field of the cotton itself for evenness, twist, and fineness. Some one hundred plants were thus marked and the crop from each picked separately. The cotton from each was further examined at leisure in the laboratory. No real comparison between the low-country samples and those from other elevations was, however, possible, since the former were merely the late pickings of the season crop, the two main pickings having been made before my arrival. Of the middle and the high elevation samples the former were distinctly the best. The general type of plant also was much more satisfactory. I attach to this report the results of the examination of the several samples which were finally selected for further propagation (see Appendix).

57. Each of these will next season be grown at suitable centres representative of the tracts from which the samples were obtained. Here they will be studied to see how far they breed true to type, and from those further selections will be made. Instructions have been given for roguing the crops and thus eliminating, as far as is possible under field conditions, any plants which are the progeny of cross-fertilization. In this way it is possible to obtain strains which to all practical purposes are true to type. When promising strains have thus been found, tests will be made for acre yield of lint, which is governed not only by ginning out-turn, but also by the setting of the bolls, the size of the seed, and the number of seeds to the boll.

Conclusions and Recommendations.

1. Cotton is grown at elevations varying from 100 to 3,000 feet above sea-level, and the difference in the climate between these extremes renders the problems connected with the cultivation of this crop more complex than they are in most cotton-growing countries.

2. Until communications within the country are improved, and the cost of internal and external transport cheapened, the area under this crop must remain restricted, unless the price of cotton is permanently raised very much higher than it is at present. As far as soil, climate, and population go, there is scope for considerable extension.

3. The tendency for extensive as opposed to intensive cultivation, which is common to all new countries, where European settlement is established, militates against the maintenance of the quality of the cotton produced. The settler thinks much more of having a large area under cultivation than a large acre yield over a smaller area. This tendency means scanty and improper cultivation, an extension of the sowing periods often long after that which will furnish an adequate return for the expenditure and labour involved, and frequently difficulty in arranging for labour at critical periods of the crop's growth. The result is an unhealthy crop, which is much more liable to insect pest and disease.

4. The complete absence of any rotation of crops not only affects the acre yield of cotton, but prevents proper cultivation and manuring. The result is a serious depletion of the fertility of the soil, and the effects of this must tell on the future prosperity and resources of the country.

5. Until recently labour was both cheap and abundant, and no attempts were made to make it more efficient. It now costs about double what it did before the war. With the development of the country by the influx of new settlers since the war there has been

a shortage of labour. This is due partly to the inefficient use made of labour, and partly to the lack of enterprise on the part of the labourer himself. Work is done on the "task" system, by which a certain task is allotted to all labourers alike. No more than this is expected from each man, and no worker has any idea of doing extra work for extra pay. Many labourers complete their work by midday, while others have to work the whole day to do the same task. There is no incentive to labour to do more than this, and there is no grade of employment between that of the daily labourer and the overseer or "capitou." Few labourers can aspire to this, since more often than not petty headmen are appointed because they can control labour. There is no doubt that labour could be made more efficient if hand implements were improved, and if bullock-power implements were more adapted to the needs of the country. The types of implements which are indigenous to India are much better adapted to the needs of the country than the expensive implements of Western agriculture, which are now being imported.

6. The Agricultural Department: Research and Experiment.—The main defect in the Agricultural Department, which, I believe, is appreciated by the departmental officers themselves, is that no one, except the Director of Agriculture himself, has had any previous practical experience of tropical agriculture before coming to the country. Native agriculture is very primitive, and the only other agriculture in the country is that of the European settler, who has had much less training of such a kind as to enable him to learn tropical agriculture than have the officers of the Agricultural Department. There can be no question, I think, that such officers would benefit greatly by post-graduate training in tropical agriculture *in the Tropics* before they are sent to their respective colonies, and, further, there can be no question, I consider, that India is the country where such training could best be given. The main crops are the same; the conditions of farming are similar; the general standard of farming is high. It is a country which is largely dependent on its own local resources for its draught power and its implements, and no one realizes better than the Indian farmer the essentials of tropical arable agriculture, which are (*a*) thorough preliminary cultivation, (*b*) timely and thorough weeding, and (*c*) the conservation of soil moisture during dry-weather conditions of the growing season. No English farmer has any conception of what clean farming is compared with the Indian standard, and it is this lack which is such a drag on progress in Nyasaland, and, I presume, in other African colonies as well.

I suggest that the Colonial Office be addressed with a view to their arranging to send all recruits for this service to India for at

least one year's training before posting them to their African posts.

They have done this in the case of one officer in Ceylon, and I have a letter before me now from him telling me how much he has benefited by the training he received in Madras. Such training is, perhaps, applicable even to a greater degree to future work in Africa than it is to work in Ceylon.

7. The existing agricultural stations are too large and the lines of work attempted are too diffuse ever to achieve reliable results. Too much attention in the past has been paid towards having a large area under cultivation rather than to the solving of definite problems.

As far as cotton goes, there is no record to show that—(1) trials have ever been made to ascertain the correct time for sowing, even with the present methods of cultivation; (2) any experiment has ever been made to ascertain the best methods of cultivation, such as comparing the ridge with the flat method of planting; (3) trials have been made to test the value of rotation crops, either to show what profit can be made from these or to test their effect on the following cotton crop; (4) any attempts have been made to utilize cattle manure to maintain the fertility of the soil. In fact, very little seems to have been done except to grow cotton on the same lines as are adopted by every farmer in the country. The only real work appears to have been in the selection of single plant strains for the improvement of the staple of Nyasaland cotton, and even of this work very little careful record seems to have been kept. The work of the expert officers of the department should be to solve agricultural problems such as these, rather than to be the managers of large Government estates.

There are two agricultural stations in the Protectorate, one near Port Herald and the other near Zomba. The former might just as well be closed down for all the good that it can do for work on cotton. It is very inaccessible and apparently very unhealthy. The lands consist partly of abandoned native clearings, which are more or less exhausted, and partly of lands on the Ndinde Marsh, which, as I have stated in my report, are of much too heavy a type for cotton to be ever anything else than a gamble. It is no place for continuous work, since in a bad season such as this last one the work of years of selection may be completely lost. The station near Zomba will be useful for studying cotton problems at the higher elevations where it is grown, but at present too much is attempted for the staff which is stationed here, and no experimental work can receive the attention that it demands. In the past, selection work has been done here and different varieties of cotton have been tested and compared, but at the present time all the work that is being

done with cotton is merely the multiplication of seed of the strains which have been produced in former years and which, as far as I could judge, have become hopelessly mixed. Improvement can be expected here, as Mr. Wortley, the present Director of Agriculture, fully realizes that the station is not fulfilling the objects with which it was started. Concentration on definite agricultural problems is necessary, as opposed to the cultivation of large areas with no definite object in view. My criticisms on present methods of cultivation in the body of the report suggest many lines of work which can be taken up here.

8. Small substations should be started by the Agricultural Department at places representative of the different zones where cotton is cultivated. These should be under the control of an officer of the Agricultural Department who will specialize in cotton. In all probability it would be possible to co-operate with growers in such a way that the station would be under the supervision of a reliable grower who would see that the instructions of the controlling officer were carried out by the native "capitou," or overseer. The difficulty in this country is that there is nothing between the ill-trained native "capitou" and the trained European officer. In the first instance, such stations would be confined to the growing and comparison of unit strains of cotton, but as the experimental work on the larger agricultural stations gave results, these could be demonstrated locally.

9. Further co-operation is needed between the Agricultural Department and reliable growers for the multiplication of seed of a proved type or types of cotton in order to standardize the cotton grown.

10. The European growers are now fairly well organized. They have a United Planters Association, with which most of the district associations are connected, and it should therefore be possible to get the growers' support to a system of grading such as I have recommended in paragraphs 31 and 32 of my report.

11. Assistance from the Empire Cotton Growing Corporation.—The Protectorate would greatly appreciate the loan of the services of an officer, at any rate for a year or two, who has had previous knowledge of cotton in a cotton-growing country, if only to assist an officer of the Agricultural Department in cotton work.

12. Standard designs for ginning factories are required. It is very evident that those which exist at present have been erected without sufficient knowledge of what is required.

13. To introduce a system of Government grading the services of an expert grader are necessary, who, besides grading cotton for export, would prepare grades and standards to which he would work up and which would be supplied to export markets and consumers of cotton.

14. Enquiry should be made into Eastern and Continental markets for the disposal of the lower grades of cotton for which there is likely to be little permanent demand on the Lancashire market. It is these lower grades which it is so difficult to dispose of at present at a profit.

15. The research and experimental branch of the Empire Cotton Growing Corporation can assist by reporting in detail on the relative values of new strains of cotton and on these when grown at different altitudes. It can also assist by drawing the attention of consumers to the merits of such cottons for particular classes of work. Brokers' reports are useful as far as they go, but are they apt to place too much value on freedom from leaf and on colour and not sufficient on twist and evenness of staple. They are also apt to overvalue small samples which have not been pressed.

16. It may be possible for the Empire Cotton Growing Corporation to render assistance in reducing the cost of marketing the crop. Mention of this has been made in paragraphs 14, 35, and 39 of the report. These present high rates, at the present prices of cotton, are strangling the cotton-growing industry, and there is little encouragement either to Europeans or to natives to grow cotton.

APPENDIX

RESULTS OF THE EXAMINATION OF PRELIMINARY SINGLE PLANT SELECTIONS

LOW COUNTRY.

Chikwawa Tract (*elevation* 350 *feet*).

No.	Twist (Max. 10).	Evenness.	Length (inches).	Fineness. (Max. 10).	Weight of Seed Cotton. Grms.	Weight of Seed. Grms.	Weight of Lint. Grms.	Ginning. Percentage.	Weight of 100 Seeds. Grms.	Lint Index.	Fuzz.*
5	9	9	1·05–1·2	9	34·02	23·5	9·93	28·6	11·5	4·36	H-FF
10	10	9	1·1 –1·25	9	46·7	33·5	13·38	28·5	10·67	4·35	FF
11	10	10	1·1 –1·15	9	47·77	33·82	13·74	28·76	11·62	4·72	FF
13	9	9	1·2 –1·3	10	24·99	18·36	6·99	26·04	11·65	4·18	FF
14	9	9	1·0 –1·2	8	46·9	33·7	12·77	27·23	12·65	5·13	FF
21	10	9	1·0 –1·15	9	38·92	26·87	11·98	30·78	11·81	5·26	FF
24	8	8	1·0 –1·15	8	43·46	30·87	12·77	29·38	11·57	4·78	FF
28	9	10	1·15–1·2	8	69·01	49·22	19·7	28·55	11·18	4·47	FF
31	9	9	1·0 –1·15	8	41·44	27·92	13·27	31·78	10·27	4·82	FF
33	8	9	1·15–1·25	10	10·85	7·6	3·22	29·68	9·7	4·37	HF
36	10	8	1·1 –1·25	10	16·53	11·06	5·2	31·46	10·08	4·70	FF
39	8	9	1·1 –1·2	9	36·07	24·78	10·97	30·41	9·78	4·33	FF
40	8	10	1·05–1·1	8	23·7	16·55	7·01	29·58	10·58	4·48	FF

MIDDLE COUNTRY.

Mlosi (*elevation about* 2,000 *feet*).

36B	9	9	1·15–1·3	10	13·90	9·65	4·25	30·58	9·65	4·25	FF
37B	10	9	1·1 –1·2	8	30·17	20·45	9·72	32·22	10·64	5·05	FF

Liwawasi (*elevation* 1,500 *feet*).

2	9	10	1·2 –1·4	10	66·4	47·32	19·08	28·73	12·61	5·08	FF
6	8	10	1·15–1·3	8	54·42	36·92	17·77	32·65	9·55	4·59	FF
7	9	10	1·15–1·2	9	79·13	56·03	23·53	29·77	10·51	4·42	FF
8	10	10	1·1 –1·2	9	101·12	66·46	35·1	34·71	11·3	5·97	FF
9	9	10	1·05–1·15	7	86·27	57·6	28·67	33·23	10·07	5·01	FF
10	8	9	1·0 –1·15	9	61·02	40·4	19·95	32·69	10·5	5·18	FF
11	8	10	1·2 –1·25	10	142·9	100·3	42·66	29·85	9·97	4·24	FF

Mpali (*elevation* 1,200–1,400 *feet*).

1	9	10	1·15–1·3	9	38·62	25·68	12·67	32·81	10·6	5·23	FF
4	10	8	1·0 –1·15	9	47·99	30·75	16·92	35·25	9·55	4·99	H-FF
5	10	9	1·05–1·2	10	42·53	29·68	12·79	30·07	10·22	4·4	FF
9	8	10	1·1 –1·2	8	62·65	40·62	21·79	34·78	11·22	6·02	FF
10	10	9	1·05–1·2	9	52·68	33·96	17·9	33·98	11·52	6·07	FF

HIGH COUNTRY.

Namiwawa Agricultural Station (*elevation about* 3,000 *feet*.)

2	9	9	1·0 –1·15	10	68·95	46·27	22·02	31·94	10·72	5·05	FF
3	8	10	1·0 –1·1	9	44·0	29·27	14·67	33·33	9·68	4·85	H-FF
4	9	10	1·1 –1·2	9	100·37	69·35	30·63	30·52	13·45	7·04	FF
10	7	9	1·1 –1·25	9	124·15	83·63	39·88	32·12	11·69	5·57	FF
15	7	10	1·0 –1·1	7	79·41	52·86	26·2	32·99	9·71	4·81	FF
17	10	10	1·1 –1·2	8	43·78	30·4	14·67	32·04 33·51	10·27	4·96	FF
18	10	9	1·1 –1·3	8	68·11	43·19	23·36	34·3 35·1	11·95	6·46	FF
19	9	10	1·1 –1·2	9	94·62	64·05	30·6	32·3	10·27	4·91	FF
21	10	10	1·0 –1·1	8	107·14	74·53	34·35	32·06	12·62	5·82	FF
24	6	10	1·15–1·2	9	47·5	32·4	14·76	31·08	11·1	5·06	FF
25	8	9	1·15–1·25	9	71·62	49·95	21·38	29·85	12·6	5·54	FF
30	9	8	0·9 –1·2	8	58·56	37·81	20·55	35·08	10·01	5·44	FF
31	8	9	1·05–1·2	9	70·22	47·27	21·70	30·9 31·44	12·0	5·51	FF

* FF = fully fuzzed. H-FF = half to fully fuzzed.

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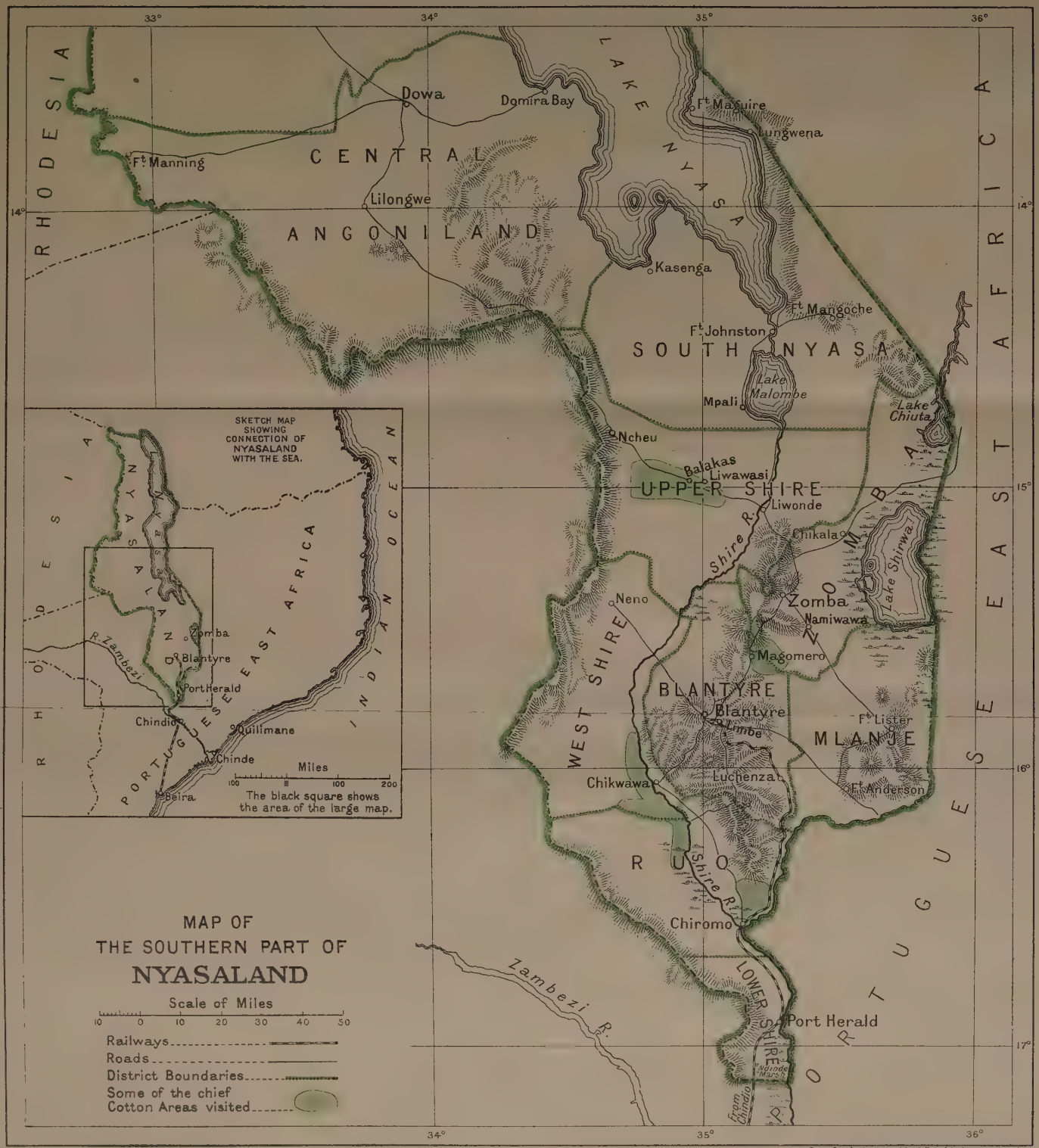

Stanford's Geographical Establishment, London.